Skungamaug River Watershed

Crandall Pond and Skungamaug River (Segment 1b)

WATERSHED DESCRIPTION AND MAPS

The Skungamaug River watershed covers an area of approximately 19,668 acres in northeastern Connecticut, east of the Connecticut River (Figure 1). The watershed is located in Andover, Bolton, Coventry, Mansfield, Vernon, Tolland, Willington, Ellington, and Stafford, CT.

The Skungamaug River watershed includes two waterbodies impaired for recreation due to elevated bacteria levels. These waterbodies were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) List of Impaired Waters. Other segments in the watershed are not supporting designated uses for recreation, but may have been taken off the 2012 303(d) List of Impaired Waters following CT DEEP assessment of 2010 data. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of other waterbodies in the watershed (CTDEEP, 2010).

The Skungamaug River begins upstream of the Skungamaug Marsh in Tolland, continues southwesterly to cross Route 84, flows through Tolland Marsh Pond and across the Coventry border, continues parallel to North River Road, crosses Route 31 into Nathan Hale State Forest, flows into northern Andover, and joins the Hop River upstream of Hendee Road just east of Route 6. The bacteria impaired waterbody, Crandall Pond (CT3106-06-1-L2_01), consists of 2.63 acres of a tributary to the Skungamaug River in Tolland, known as Paulk Hill Brook (Figure 2). Paulk Hill Brook begins just upstream of the Route 74 crossing, crosses Old Post Road, enters Crandall's Park at Cider Mill Pond (or Crandall Pond), and ends at the Tolland Marsh Pond complex downstream of the Route 84 crossing. The bacteria impaired segment, Skungamaug River (Segment 1b) (CT3106-00_01b), consists of 6.27 miles of river in Tolland. The Skungamaug River (Segment 1b) begins at the headwaters upstream of the Old Tolland Road crossing, flows through the Skungamaug Marsh, crosses Route 74 and Interstate 84, continues through Tolland Marsh Pond, and ends at the inlet to Summer Lake above Anderson Road in Tolland.

Impaired Waterbody Facts

Impaired Waterbodies/Segment Length or Area:

1. Crandall Pond (CT3106-06-1-L2_01); 2.63 acres
2. Skungamaug (Segment 1b) (CT3106-00_01b); 6.27 miles

Town: Tolland

Water Quality Classification: Class A

Designated Use Impairment: Recreation

Sub-regional Basin Name and Code: Skungamaug River, 3106

Regional Basin: Willimantic

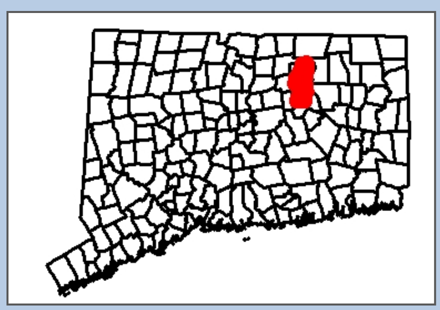
Major Basin: Thames

Watershed Area (acres): 19,668

MS4 Applicable? Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

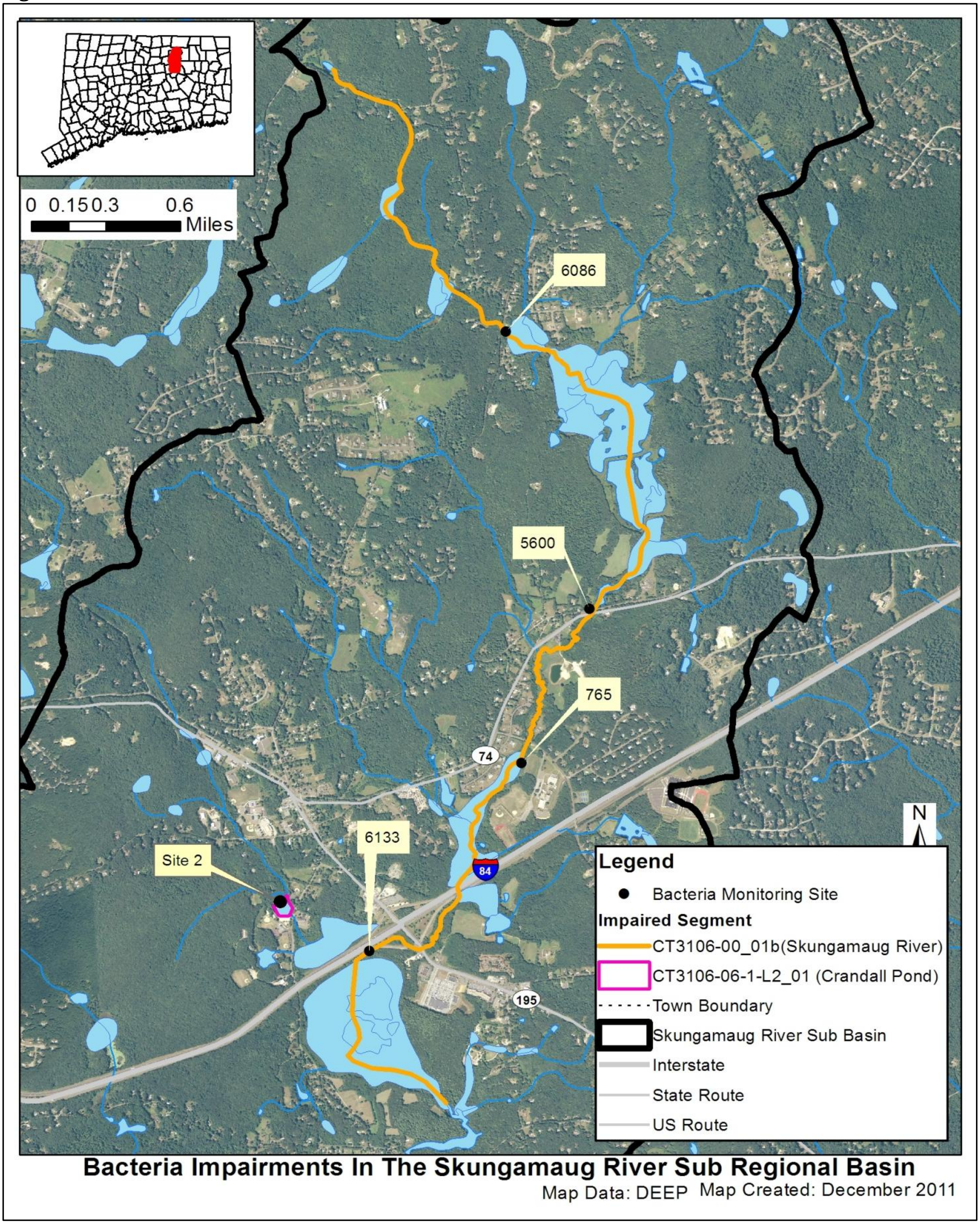


Crandall Pond and the Skungamaug River (Segment 1b) have a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Crandall Pond is a designated beach and the specific recreation impairment is for designated swimming and other water contact related activities.

Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles/ Acres	Aquatic Life	Recreation	Fish Consumption
CT3106-06-1-L2_01	Crandall Pond (Cider Mill Pond) (Tolland)	Cider Mill Road, Tolland (just north of I84, in Crandall Park) formerly CT3106-00-2-L2_01 (wrong waterbody)	2.63	U	NOT	FULL
CT3106-00_01	Skungamaug River-01	From mouth at confluence with Hop River, Andover, US to headwaters (US of Old Tolland Road crossing), Tolland.	16.7	U	NOT*	FULL
CT3106-00_01b	Skungamaug River-01b	From inlet to Summer Lake (lake in seg-01) above Anderson Road, US to headwaters (US of Old Tolland Road crossing), Tolland.	6.29	FULL	NOT	FULL
Shaded cells indicate impaired segment addressed in this TMDL						
***This segment was split into a _01a and _01b to create two smaller pieces for assessment**						
FULL = Designated Use Fully Supported						
NOT = Designated Use Not Supported						
U = Unassessed						

Figure 2: GIS map featuring general information of the Skungamaug River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, land use within the Skungamaug River watershed consists of 68% forest, 20% urban, 8% agriculture, and 4% water. Upstream of Crandall Pond, the headwaters of Paulk Hill Brook begin in a forested, low density development area, and continue along the commercial development of Route 74, which includes a dog grooming business, shopping area, senior center, and preschool. To the east of Paulk Hill Brook are Parker Memorial School and Tolland Intermediate School with large parking lots, three baseball fields, and one soccer field. To the west of Paulk Hill Brook is an industrial area with exposed soil adjacent to the stream. The area immediately surrounding Crandall Pond is very developed with a baseball field and parking lot along the north shore, and an artificial beach, playground, parking lot, two baseball fields, and tennis courts along the south shore. Cider Mill Road runs adjacent to the southeast shore of Crandall Pond, providing little vegetated buffer between the road, the First Baptist Church of Tolland parking lot, and the pond edge. The upper half of the Skungamaug River (Segment 1b) is primarily forested mixed with rural development and agricultural hayfields near the headwaters. The lower half of the Skungamaug River (Segment 1b) flows parallel to Route 74 near developed areas, particularly a mowed field next to an open gravel pit and pond and school recreational fields upstream of Interstate 84.

Figure 3: Land use within the Skungamaug River watershed

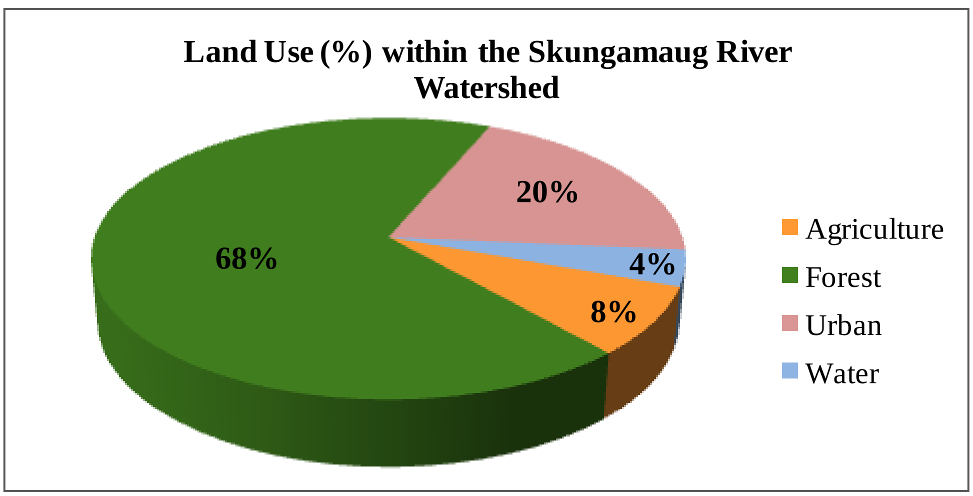
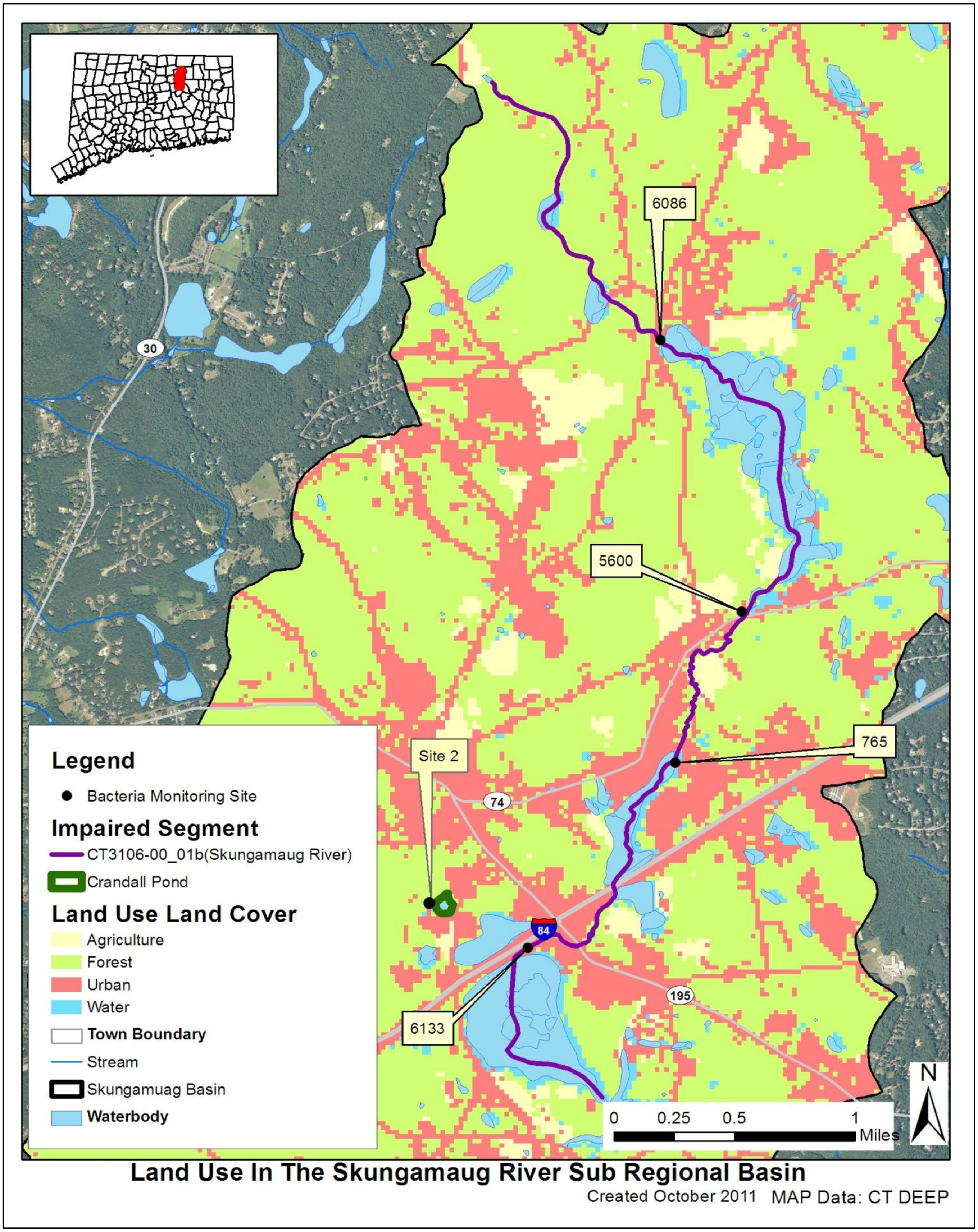


Figure 4: GIS map featuring land use for the Skungamaug River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired waterbodies.

Table 2: Sampling station location description for the impaired waterbodies in the Skungamaug River watershed

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT3106-06-1-L2_01	Skungamaug River (Crandall Pond)	Site 1	Left side of pond	Tolland	--	--
		Site 2	Right side of pond	Tolland	--	--
CT3106-00_01b	Skungamaug River (Segment 1b)	6133	Route 195 crossing	Tolland	41.86233	-72.363362
		6086	At Stafford Road	Tolland	41.89978	-72.35246
		5600	Downstream of Route 74	Tolland	41.883	-72.346
		765	Downstream of Old Cathole Road	Tolland	41.87369	-72.351411

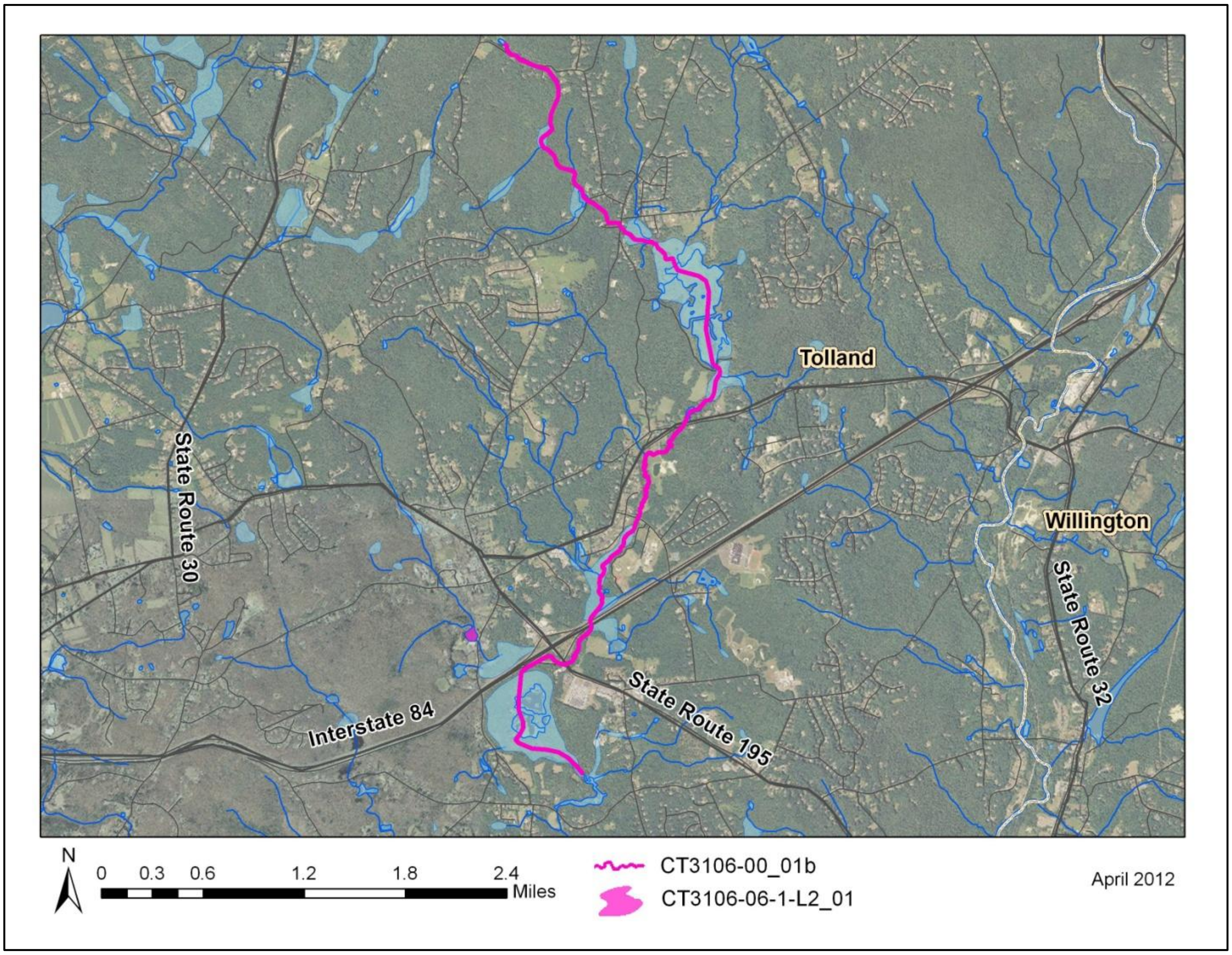
Crandall Pond (CT3106-06-1-L2_01) and the Skungamaug River (Segment 1b) are Class A freshwater waterbodies (Figure 5). Their applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Water quality analyses were conducted using data from two sampling locations (Site 1 and Site 2) from 2008-2011 at Crandall Pond, and from four sampling locations (Stations 6133, 6086, 5600, and 765) from 2002-2003 and 2006-2010 on the Skungamaug River (Segment 1b) (Table 2). To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Tables 9 and 10).

Crandall Pond (CT3106-06-1-L2_01): As shown in Table 9, geometric mean values for both Site 1 and Site 2 did not exceed the WQS for *E. coli* in any sampling year. Single sample values at both stations exceeded the WQS for *E. coli* multiple times in all sampling years, except 2011. For Crandall Pond, both sites showed geometric mean bacteria levels to be approximately six times higher in wet-weather than in dry.

Skungamaug River (Segment 1b) (CT3106-00_01b): As shown in Table 10, geometric mean values exceeded the WQS for *E. coli* multiples times at Station 765 and once at Station 6133 in 2010. Single sample values exceeded the WQS for *E. coli* multiple times in multiple years at Station 765 and multiple times in 2010 at Station 6133. Stations 765 and 6133 also had geometric mean bacteria levels exceed the WQS for *E. coli* during both wet and dry-weather conditions.

Due to the elevated bacteria measurements presented in Tables 9 and 10, these impaired waterbodies did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of Crandall Pond and the Skungamaug River (Segment 1b)



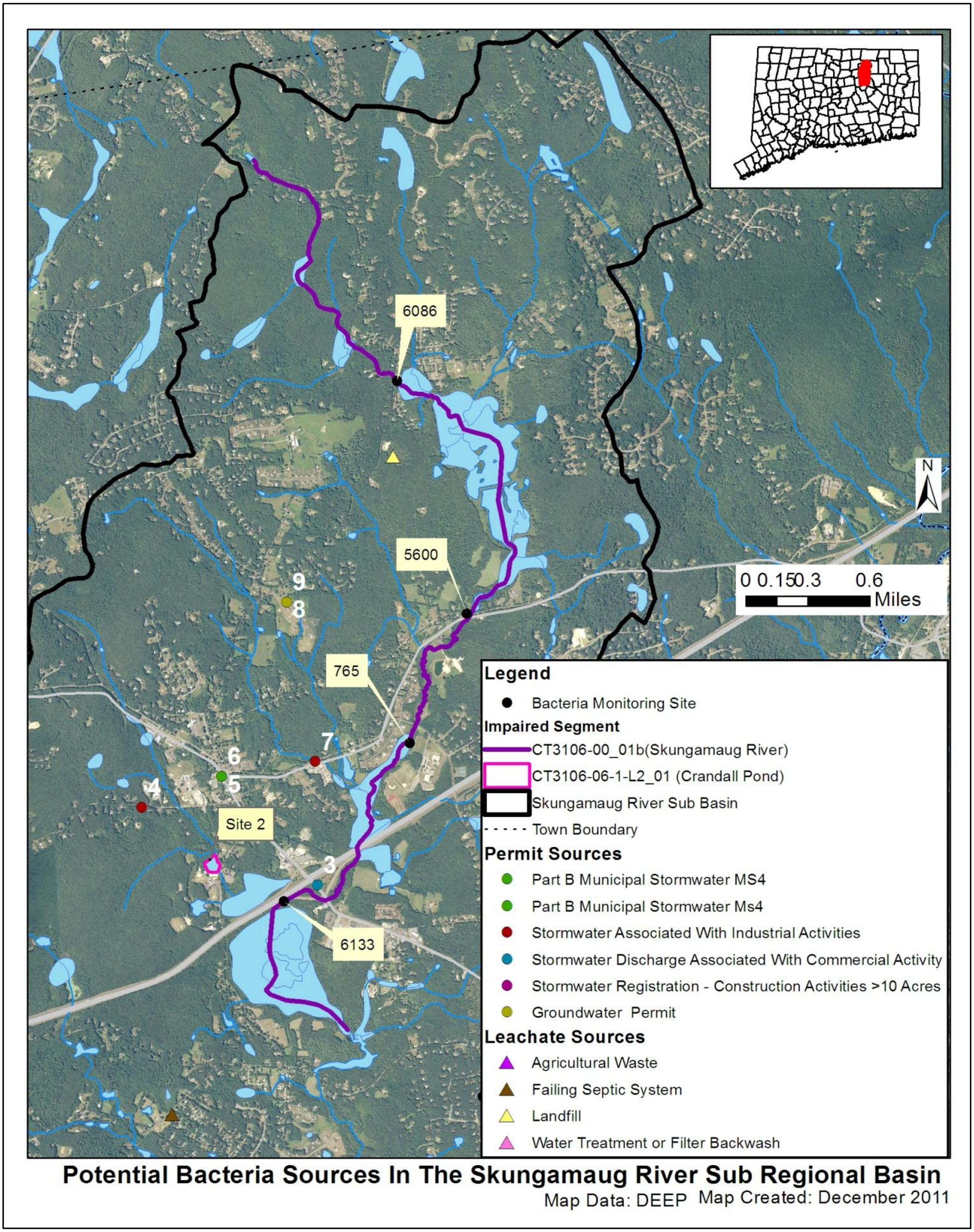
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the Skungamaug River watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbodies is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional sources. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Skungamaug River watershed

Impaired waterbody	Permit Source	Illicit Discharge	CSO/ SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Crandall Pond CT3106-06-1-L2_01	x			x	x	x	x	
Skungamaug River (Segment 1b)	x			x	x	x	x	x

Figure 6: Potential sources in the Skungamaug River watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	1
GSI	Stormwater Associated with Industrial Activity	2
GSM	Part B Municipal Stormwater MS4	2
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	3

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Skungamaug River watershed. Bacteria data are currently not available for any of the permitted discharges. Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Skungamaug River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Tolland	Capitol Ventures Llc.	GSC000294	Stormwater Discharge Associated With Commercial Activity	Fieldstone Commons	3
Tolland	Town Of Tolland	GSI002201	Stormwater Associated With Industrial Activities	Tolland Highway Garage	4
Tolland	Bill's Auto Parts, Inc.	GSI002385	Stormwater Associated With Industrial Activities	Bill's Auto Parts, Inc.	7
Tolland	Town Of Tolland	GSM000100 / 200902788	Part B Municipal Stormwater MS4	Tolland, Town Of	NA
Tolland	Town Of Tolland	UI0000312	Groundwater Permit	Birch Grove School	8
Tolland	K-D Gateway Llc	UI0000059	Groundwater Permit	K-D Gateway, Llc	9
Tolland	Stone Pond Condominium Association, Inc.	UI0000060	Groundwater Permit	Stone Pond Condominium Association, Inc.	2
Conventry	Town of Coventry	GSN002136	Stormwater Registration - Construction Activities >10 Acres	Future Public Works Facility	1

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired waterbodies are located within the Town of Tolland. Portions of Tolland near the impaired waterbodies are designated urban areas, as defined by the U.S. Census Bureau, and Tolland is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by CT DEEP (Figure 10). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Multiple MS4 outfalls have been sampled for *E. coli* bacteria in the watershed (Table 6). In Tolland, six MS4 outfalls were sampled from 2008-2011, and all outfalls exceeded the single sample water quality standard of 410 colonies/100 mL on at least one sampling day.

Figure 7: MS4 areas of the Skungamaug River watershed

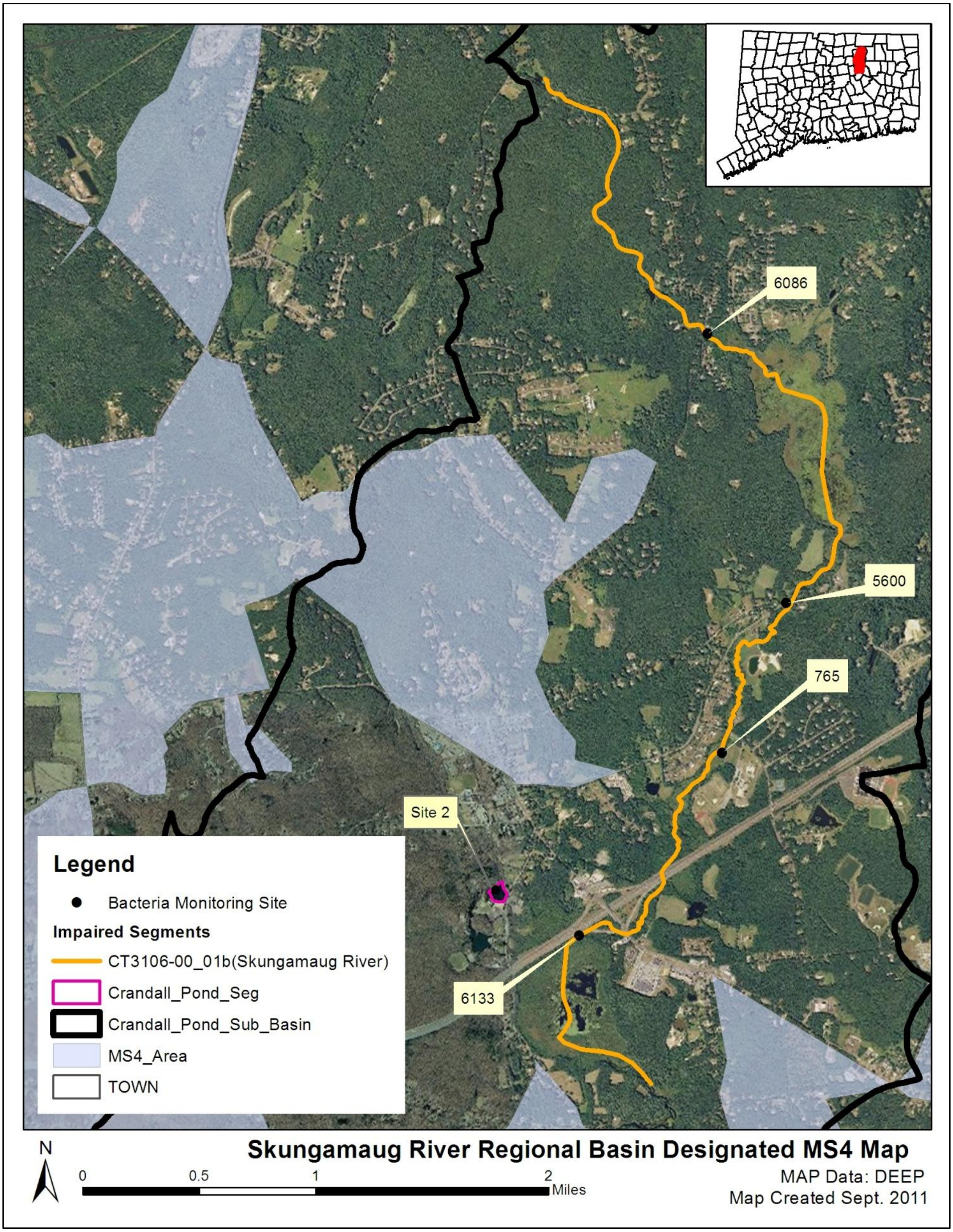


Table 6: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Skungamaug River watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Tolland	Clough Brook, Skungamaug River Basin	Residential	Clough Brook	09/28/10	610
Tolland	Clough Brook, Skungamaug River Basin	Residential	Clough Brook	11/04/10	3,260
Tolland	Clough Brook, Skungamaug River Basin	Residential	Clough Brook	09/22/11	220
Tolland	Discharge at Woodland Street and Gehring Road Extension	Unknown	Unknown	09/26/08	24,200
Tolland	Discharge at Woodland Street and Gehring Road Extension	Unknown	Unknown	11/25/08	130
Tolland	Discharge at Woodland Street and Gehring Road Extension	Unknown	Unknown	08/06/09	2,000
Tolland	Discharge on the north side of Anderson Road	Unknown	Unknown	09/26/08	820
Tolland	Discharge on the north side of Anderson Road	Unknown	Unknown	11/25/08	870
Tolland	Discharge on the north side of Anderson Road	Unknown	Unknown	08/06/09	2,000
Tolland	Discharge on the south side of Torry Road	Unknown	Unknown	09/26/08	24,200
Tolland	Discharge on the south side of Torry Road	Unknown	Unknown	11/25/08	24,200
Tolland	Discharge on the south side of Torry Road	Unknown	Unknown	08/06/09	2,000
Tolland	Unnamed Brook, Skungamaug River Basin	Residential	Unnamed Brook	09/28/10	24,200
Tolland	Unnamed Brook, Skungamaug River Basin	Residential	Unnamed Brook	11/04/10	24,200
Tolland	Unnamed Brook, Skungamaug River Basin	Residential	Unnamed Brook	09/22/11	5,790
Tolland	Unnamed Tributary to Metcalf Brook, Skungamaug River Basin	Residential	Unnamed Tributary to Metcalf Brook	09/28/10	24,200
Tolland	Unnamed Tributary to Metcalf Brook, Skungamaug River Basin	Residential	Unnamed Tributary to Metcalf Brook	11/04/10	1,400
Tolland	Unnamed Tributary to Metcalf Brook, Skungamaug River Basin	Residential	Unnamed Tributary to Metcalf Brook	09/22/11	4,350
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Publicly Owned Treatment Works

As shown in Figure 7, there are no publicly owned treatment works (POTW), or wastewater treatment plants, in the Skungamaug River watershed, and therefore, POTWs are not a potential source of loading to the impaired waterbodies.

<u>Non-point Sources</u>

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Skungamaug River watershed are described below.

Recreation at Crandall Pond Beach

People coming in direct contact with surface water presents a potential source of bacterial contamination. Microbial source tracking (MST) surveys conducted in New Hampshire have shown humans to be a source of bacterial contamination at beaches (Jones, 2008). Since there is a designated beach on Crandall Pond, it is probable that humans are depositing fecal matter with high levels of bacteria directly into Crandall Pond at the beach.

Stormwater Runoff from Developed Areas

Approximately 20% of the land use in the watershed is considered urban, and the impaired waterbodies are located within the commercial and residential development along Route 74 in Tolland (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

Although the majority of the area surrounding the impaired waterbodies is less than 6% impervious cover, Crandall Pond is located near a shopping area, senior center, preschool, Parker Memorial School, Tolland Intermediate School, First Baptist Church of Tolland, and Cider Mill Pond parking lot, and the Skungamaug River (Segment 1b) flows through commercial development along Route 74 (Figures 8 and 9). Water quality data taken at several stations along the impaired waterbodies exceeded the geometric mean during wet-weather, which suggests that stormwater runoff may be a source of bacteria to the Skungamaug River (Segment 1b) and Crandall Pond (Tables 9 and 10). Bacteria data from the MS4 monitoring program also suggest that stormwater is a source of bacteria. The MS4 outfall sampling site along Clough Brook, located upstream of Paulk Hill Brook within similar development, exceeded the single sample limit in 2010. Downstream of Paulk Hill Brook, an MS4 outfall sampling site along a tributary to Metcalf Brook also exceeded the single sample limit in 2010 and 2011.

Figure 8: Range of impervious cover (%) in the Skungamaug River watershed

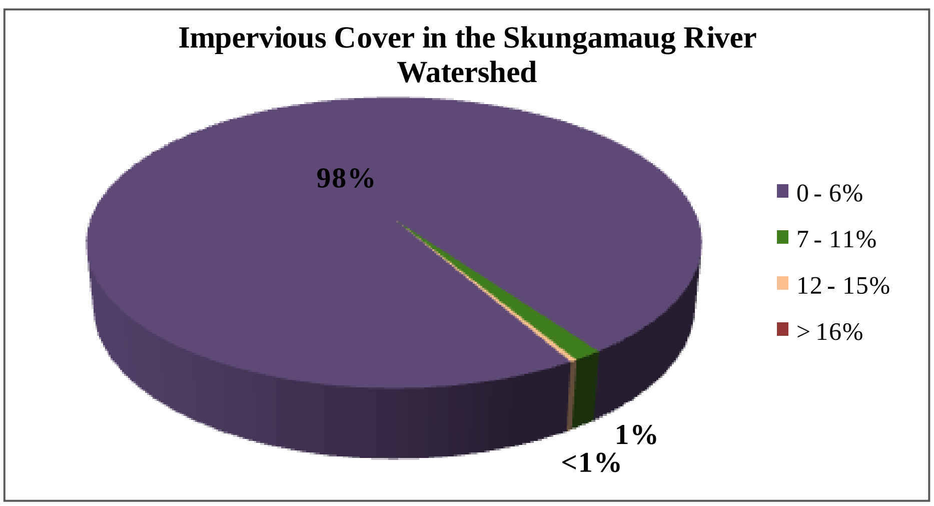
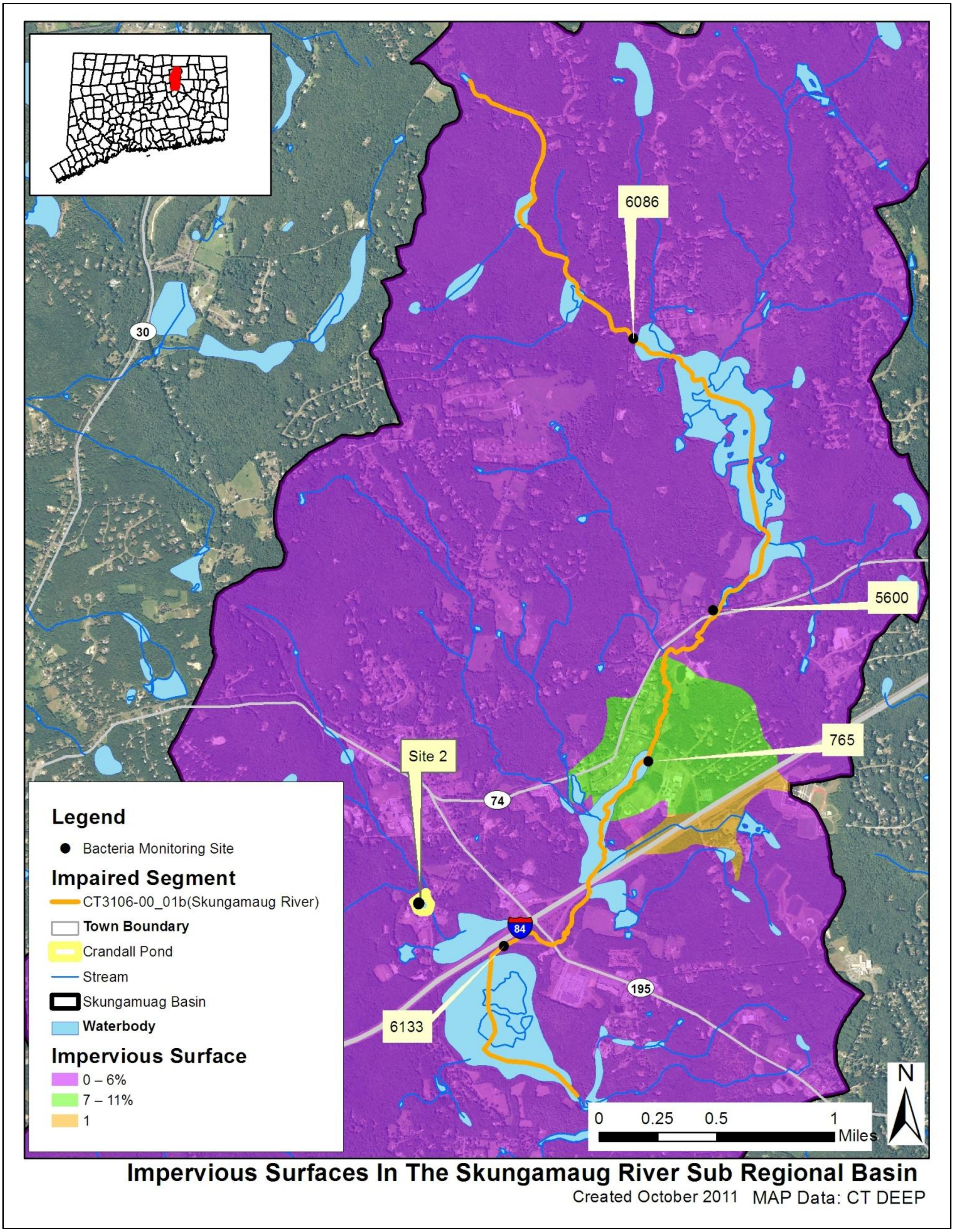


Figure 9: Impervious cover (%) for the Skungamaug River sub-regional watershed



Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, the area surrounding the impaired waterbodies relies solely on onsite wastewater treatment systems, such as septic systems. Although located downstream of the impaired waterbodies, a failing septic system was identified in Figure 6 and may be indicative of a more widespread issue in the watershed. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Tolland is part of the Eastern Highlands Health District (http://www.ehhd.org).

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Skungamaug River watershed represent a potential source of bacteria to surface waters. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001). As the majority of the watershed is undeveloped, particularly in the northern half of the watershed, wildlife waste is a potential source of bacteria to the impaired waterbodies. The playground and recreation areas along the south and northeast bank of Crandall Pond encourage dog owners to utilize the space, and residential development along Route 74 near the Skungamaug River (Segment 1b) may harbor large dog populations. As such, pet waste may also be contributing to bacteria concentrations in the impaired waterbodies of the Skungamaug River watershed.

Large recreational fields upstream of Crandall Pond at Parker Memorial School and Tolland Intermediate School and immediately adjacent to the south and northeast bank of Crandall Pond serve as waterfowl attractants. Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural crop fields, and golf courses. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

Additional Sources

There are several additional sources of bacteria that may be contributing to or help explain the impairment in Crandall Pond. Several industrial activities permits were identified upstream of Crandall Pond in Figure 6, including one at Tolland Highway Garage directly adjacent to Paulk Hill Brook. This area is characterized by large patches of exposed soil and non-buffered paved areas. A landfill was also identified in Figure 6 along the Skungamaug River (Segment 1b) near the Skungamaug Marsh.

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Skungamaug River watershed. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

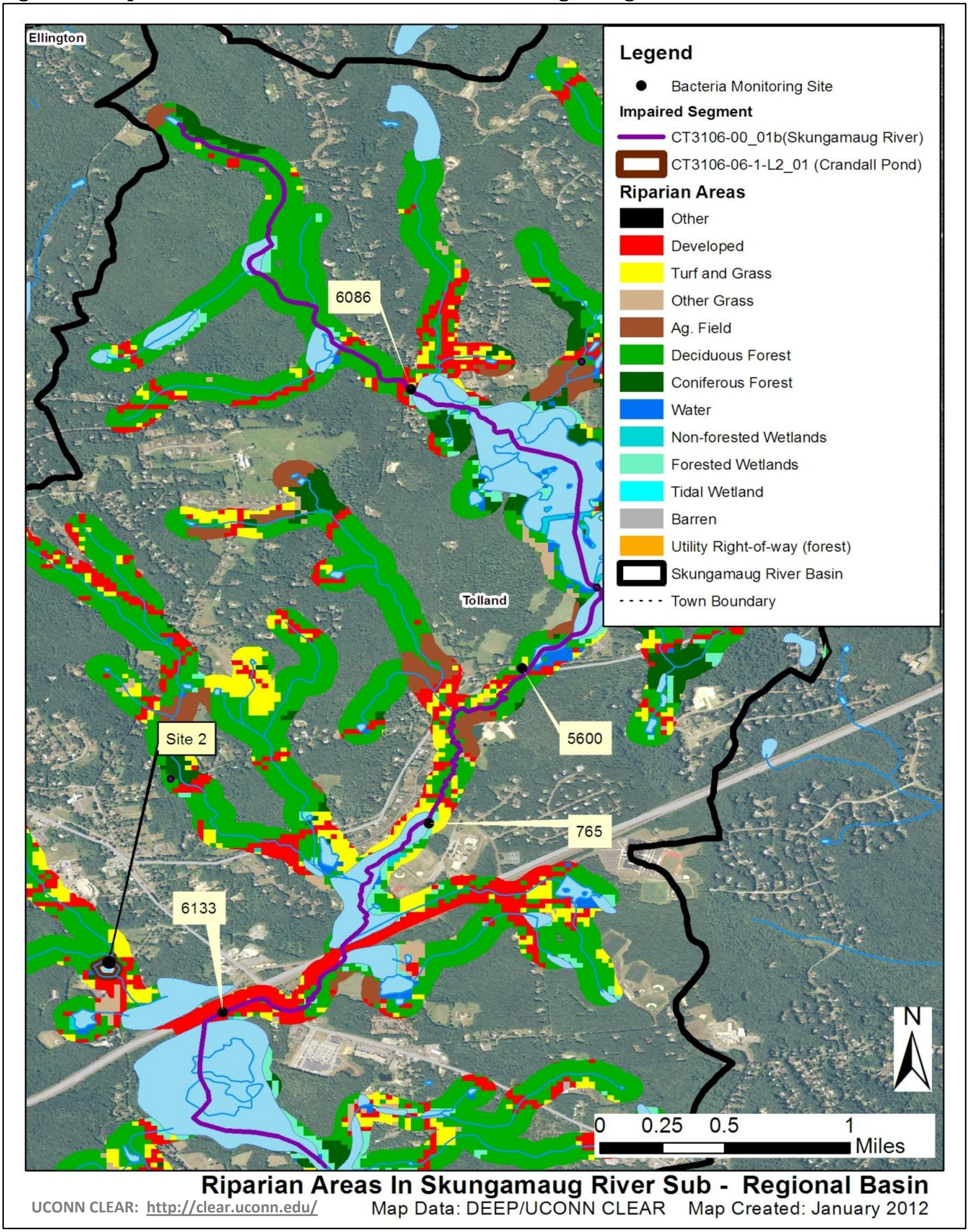
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their unique soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired waterbody of Crandall Pond is characterized by developed land use to the south and east at the beach, parking lots, First Baptist Church of Tolland, and playground, and forested land use to the northwest within Crandall's Park (Figure 10). The majority of the riparian zone of the Skungamaug River (Segment 1b) is characterized by forested land use with areas of development, turf/grass, and agriculture. As previously noted, if not properly treated, runoff from developed areas may contain pollutants such as bacteria and nutrients.

Figure 10: Riparian buffer zone information for the Skungamaug River watershed



CURRENT MANAGEMENT ACTIVITIES

CT DEEP's Non-Point Source Pollution Program administers a Non-Point Source Grant Program with funding from EPA under Section 319 of the Clean Water Act (319 grant). A $10,000 319 grant was awarded to the Town of Tolland to develop a watershed based plan for Crandall Pond to investigate the potential sources of bacteria to the swimming area (http://www.depdata.ct.gov/maps/nps/npsmap.htm). This watershed based plan has yet to be completed.

As indicated previously, Tolland is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the state. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each town is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Table 7.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Tolland, CT (GSM000100)

Minimum Measure	Tolland Annual Report (2010)
Public Outreach and Education	1) Sponsored public hearing for the development of LID stormwater treatment systems performance requirements and road design stormwater management. 2) Sponsored public workshops for the development of the Plan of Conservation and Development (Stormwater and Water Quality).
Public Involvement and Participation	1) Held a public presentation on non-point source pollution discharges. 2) Held a public presentation on winter storm procedures on the elimination of road sanding.
Illicit Discharge Detection and Elimination	1) Implemented an ordinance to effectively prohibit non-stormwater discharges. 2) Informed town employees, businesses, and the public of hazards associated with illegal discharges and improper waste disposal. 3) Mapped 50% of all outfalls greater than 12". 4) Developing a program to detect and eliminate existing illicit discharges.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Tolland, CT (GSM000100) (continued)

Minimum Measure	Tolland Annual Report (2010)
Construction Site Stormwater Runoff Control	1) Will update existing regulations to incorporate specific MS4 requirements.
Post Construction Stormwater Management	1) Will update existing regulations to incorporate specific MS4 requirements that address stormwater runoff from qualifying new development and redevelopment.
Pollution Prevention and Good Housekeeping	1) Combined Spill Prevention Control and Countermeasure and Stormwater Pollution Prevention Plan for the Town Highway Garage and Park Department. 2) Stenciled 30% of stormwater catch basins that drain directly to local rivers and ponds. 3) Continued to conduct annual cleaning and maintenance of all catch basins and other stormwater structures. 4) Continued to conduct annual street sweeping. 5) Initiated construction of a stormwater collection/retention basin in area of a future gasoline and diesel storage and dispensing aboveground storage tank and at the Town of Tolland Training Center.

RECOMMENDED NEXT STEPS

The Town of Tolland has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of Crandall Pond and have been prioritized below.

1) Evaluate municipal education and outreach programs regarding animal waste.

As most of the Skungamaug River watershed is undeveloped and the designated beach area at Crandall Pond is frequented by geese, pets, and humans, any education and outreach program should highlight the importance of not feeding waterfowl and wildlife, picking up after dogs and other pets, and properly disposing human waste (such as diapers) along Crandall Pond beach. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in riparian areas frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments and can harm human health and the environment. Animal and human wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal and human waste on water quality include installing signage, providing waste receptacles in high-use areas, enacting ordinances requiring the clean-up of waste, and targeting educational and outreach programs in problem areas.

2) Identify areas along the Skungamaug River and Crandall Pond to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 20% of the Skungamaug River watershed is considered urban, and the Town of Tolland is an MS4 community regulated by the MS4 program. The impaired waterbodies are located near commercial development along Route 74 and immediately adjacent to several large parking lots. As such, stormwater runoff is most likely contributing bacteria to the waterbodies. To identify areas that are contributing bacteria to the impaired waterbodies, Tolland should conduct wet-weather sampling at stormwater outfalls that discharge directly to the impaired waterbodies in the Skungamaug River watershed. To treat stormwater runoff, the town should identify areas along the impaired waterbodies to install BMPs that encourage stormwater to infiltrate the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

3) Develop a system to monitor septic systems.

All residents near the impaired waterbodies in the Skungamaug River watershed rely on septic systems. If not already in place, Tolland should establish a program to ensure that existing septic systems are properly operated and maintained, and create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of sub-standard systems within a reasonable timeframe can be adopted. Tolland can also develop a program to assist citizens with the replacement and repair of older and failing systems.

4) Continue monitoring of permitted sources.

Previous discharge sampling from several MS4 outfall sampling sites, particularly along Clough Brook and a tributary to Metcalf Brook, have shown single sample value WQS *E. coli* exceedances. Although no bacteria data was available for the permitted sources listed in Table 6, one industrial permit at the Tolland Highway Garage, just upstream of Crandall Pond and adjacent to Paulk Hill Brook, should be monitored for erosion from exposed soil areas and stormwater runoff from paved surfaces. Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 8 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Skungamaug watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 8. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	1	2	3	1	2	3	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with “natural levels” if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 9: Crandall Pond Bacteria Data

Waterbody ID: CT3106-06-1-L2_01

Characteristics: Freshwater, Class A, Potential Drinking Water Supplies, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 235 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **NA**

Single Sample: **88%**

Data: 2008-2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 1	Left Side	5/19/2008	20	dry	95
Site 1	Left Side	5/27/2008	10	wet	
Site 1	Left Side	6/2/2008	10	dry	
Site 1	Left Side	6/9/2008	340	wet	
Site 1	Left Side	6/11/2008	20	dry	
Site 1	Left Side	6/16/2008	280	wet	
Site 1	Left Side	6/18/2008	1000	wet	
Site 1	Left Side	6/19/2008	480	dry	
Site 1	Left Side	6/24/2008	**2000* (88%)**	wet	
Site 1	Left Side	6/30/2008	780	wet	
Site 1	Left Side	7/2/2008	75	dry	
Site 1	Left Side	7/7/2008	140	dry	
Site 1	Left Side	7/14/2008	20	wet	
Site 1	Left Side	7/21/2008	31	wet	
Site 1	Left Side	7/28/2008	1400	wet	
Site 1	Left Side	7/30/2008	150	dry	
Site 1	Left Side	8/5/2008	210	wet	
Site 1	Left Side	8/6/2008	210	wet	
Site 1	Left Side	8/11/2008	10	wet	
Site 1	Left Side	8/18/2008	20	dry	
Site 1	Left Side	8/26/2008	10	dry	

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 1	Left Side	5/18/2009	10	dry	78
Site 1	Left Side	5/26/2009	240	dry	
Site 1	Left Side	6/1/2009	10	dry	
Site 1	Left Side	6/8/2009	20	dry	
Site 1	Left Side	6/15/2009	1000	wet	
Site 1	Left Side	6/17/2009	1300	dry	
Site 1	Left Side	6/18/2009	450	wet	
Site 1	Left Side	6/19/2009	560	wet	
Site 1	Left Side	6/22/2009	31	wet	
Site 1	Left Side	6/29/2009	380	dry	
Site 1	Left Side	7/6/2009	42	dry	
Site 1	Left Side	7/13/2009	31	dry	
Site 1	Left Side	7/20/2009	10	dry	
Site 1	Left Side	7/27/2009	140	wet	
Site 1	Left Side	8/3/2009	120	wet	
Site 1	Left Side	8/10/2009	10	dry	
Site 1	Left Side	8/19/2009	10	dry	
Site 1	Left Side	8/24/2009	310	wet	

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 1	Left Side	5/24/2010	10	dry	66
Site 1	Left Side	6/1/2010	20	wet	
Site 1	Left Side	6/7/2010	**2000* (88%)**	wet	
Site 1	Left Side	6/10/2010	87	wet	
Site 1	Left Side	6/14/2010	110	wet	
Site 1	Left Side	6/17/2010	31	dry	
Site 1	Left Side	6/21/2010	1700	dry	
Site 1	Left Side	6/23/2010	1400	wet	
Site 1	Left Side	6/24/2010	410	wet	
Site 1	Left Side	6/25/2010	110	dry	
Site 1	Left Side	6/28/2010	31	dry	
Site 1	Left Side	7/6/2010	10	dry	
Site 1	Left Side	7/15/2010	120	wet	
Site 1	Left Side	7/19/2010	20	dry	
Site 1	Left Side	7/26/2010	64	dry	
Site 1	Left Side	8/2/2010	10	dry	
Site 1	Left Side	8/9/2010	10	dry	
Site 1	Left Side	8/16/2010	10	dry	
Site 1	Left Side	5/23/2011	64	wet	59
Site 1	Left Side	5/31/2011	480	wet	
Site 1	Left Side	6/2/2011	53	dry	
Site 1	Left Side	6/6/2011	10	dry	
Site 1	Left Side	6/13/2011	220	wet	
Site 1	Left Side	6/20/2011	64	dry	
Site 1	Left Side	6/28/2011	290	dry	
Site 1	Left Side	7/1/2011	10	dry	
Site 1	Left Side	7/5/2011	10	dry	
Site 1	Left Side	7/11/2011	53	dry	
Site 1	Left Side	7/19/2011	87	dry	

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 2	Right Side	5/19/2008	10	dry	**115* (NA)**
Site 2	Right Side	5/27/2008	10	wet	
Site 2	Right Side	6/2/2008	10	dry	
Site 2	Right Side	6/9/2008	450	wet	
Site 2	Right Side	6/11/2008	10	dry	
Site 2	Right Side	6/16/2008	300	wet	
Site 2	Right Side	6/18/2008	1700	wet	
Site 2	Right Side	6/19/2008	660	dry	
Site 2	Right Side	6/24/2008	**2000* (88%)**	wet	
Site 2	Right Side	6/30/2008	660	wet	
Site 2	Right Side	7/2/2008	120	dry	
Site 2	Right Side	7/7/2008	87	dry	
Site 2	Right Side	7/14/2008	10	wet	
Site 2	Right Side	7/21/2008	220	wet	
Site 2	Right Side	7/28/2008	1700	wet	
Site 2	Right Side	7/30/2008	190	dry	
Site 2	Right Side	8/5/2008	340	wet	
Site 2	Right Side	8/6/2008	120	wet	
Site 2	Right Side	8/11/2008	64	wet	
Site 2	Right Side	8/18/2008	53	dry	
Site 2	Right Side	8/26/2008	10	dry	

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 2	Right Side	5/18/2009	10	dry	79
Site 2	Right Side	5/26/2009	150	dry	
Site 2	Right Side	6/1/2009	10	dry	
Site 2	Right Side	6/8/2009	10	dry	
Site 2	Right Side	6/15/2009	620	wet	
Site 2	Right Side	6/17/2009	1000	dry	
Site 2	Right Side	6/18/2009	380	wet	
Site 2	Right Side	6/19/2009	700	wet	
Site 2	Right Side	6/22/2009	42	wet	
Site 2	Right Side	6/29/2009	140	dry	
Site 2	Right Side	7/6/2009	10	dry	
Site 2	Right Side	7/13/2009	75	dry	
Site 2	Right Side	7/20/2009	20	dry	
Site 2	Right Side	7/27/2009	99	wet	
Site 2	Right Side	8/3/2009	310	wet	
Site 2	Right Side	8/5/2009	590	dry	
Site 2	Right Side	8/7/2009	110	dry	
Site 2	Right Side	8/10/2009	10	dry	
Site 2	Right Side	8/19/2009	10	dry	
Site 2	Right Side	8/24/2009	220	wet	

Single sample *E. coli* (colonies/100 mL) data from Sites 1 and 2 on Crandall Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
Site 2	Right Side	5/24/2010	10	dry	59
Site 2	Right Side	6/1/2010	20	wet	
Site 2	Right Side	6/7/2010	**2000* (88%)**	wet	
Site 2	Right Side	6/10/2010	42	wet	
Site 2	Right Side	6/14/2010	450	wet	
Site 2	Right Side	6/17/2010	10	dry	
Site 2	Right Side	6/21/2010	1300	dry	
Site 2	Right Side	6/23/2010	**2000* (88%)**	wet	
Site 2	Right Side	6/24/2010	410	wet	
Site 2	Right Side	6/25/2010	75	dry	
Site 2	Right Side	6/28/2010	20	dry	
Site 2	Right Side	7/6/2010	10	dry	
Site 2	Right Side	7/15/2010	150	wet	
Site 2	Right Side	7/19/2010	10	dry	
Site 2	Right Side	7/26/2010	42	dry	
Site 2	Right Side	8/2/2010	10	dry	
Site 2	Right Side	8/9/2010	10	dry	
Site 2	Right Side	8/16/2010	10	dry	
Site 2	Right Side	5/23/2011	20	wet	67
Site 2	Right Side	5/31/2011	210	wet	
Site 2	Right Side	6/2/2011	87	dry	
Site 2	Right Side	6/6/2011	10	dry	
Site 2	Right Side	6/13/2011	210	wet	
Site 2	Right Side	6/20/2011	110	dry	
Site 2	Right Side	6/28/2011	150	dry	
Site 2	Right Side	7/5/2011	20	dry	
Site 2	Right Side	7/11/2011	42	dry	
Site 2	Right Side	7/19/2011	160	dry	

Shaded cells indicate an exceedance of water quality criteria

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for Sites 1 and 2 on Crandall Pond

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
Site 1	Left Side	2008-2011	29	39	76	198	37
Site 2	Right Side	2008-2011	26	40	82	242	38
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gage at Norwich Public Utility Plant in Norwich, CT							

Table 10: Skungamaug River Bacteria Data

Waterbody ID: CT3106-00_01b

Characteristics: Freshwater, Class A, Potential Drinking Water Supplies, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **67%**

Single Sample: **90%**

Data: 2002-2003, 2006-2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all stations on the Skungamaug River (Segment 1b) with annual geometric means calculated

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
6133	Route 195 crossing	6/14/2010	750	wet	**385* (67%)**
6133	Route 195 crossing	6/23/2010	**4100* (90%)**	wet	
6133	Route 195 crossing	6/28/2010	240	dry	
6133	Route 195 crossing	7/8/2010	200	dry	
6133	Route 195 crossing	7/13/2010	170	wet	
6133	Route 195 crossing	7/22/2010	1400	dry	
6133	Route 195 crossing	7/29/2010	260	dry	
6133	Route 195 crossing	8/5/2010	460	wet	
6133	Route 195 crossing	8/11/2010	160	dry	
6133	Route 195 crossing	8/19/2010	230	dry	
6133	Route 195 crossing	9/15/2010	180	dry	
6086	At Stafford Road	8/31/2010	31	dry	18
6086	At Stafford Road	9/7/2010	10	dry	
5600	Downstream of Route 74	8/31/2010	41	dry	20
5600	Downstream of Route 74	9/7/2010	10	dry	

Single sample *E. coli* (colonies/100 mL) data from all stations on the Skungamaug River (Segment 1b) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
765	Downstream of Old Cathole Road	5/22/2002	10	dry	23
765	Downstream of Old Cathole Road	8/6/2002	10	dry	
765	Downstream of Old Cathole Road	10/10/2002	120	dry	
765	Downstream of Old Cathole Road	4/10/2003	15†	dry	NA
765	Downstream of Old Cathole Road	6/14/2006	130	wet	152
765	Downstream of Old Cathole Road	6/28/2006	170	wet	
765	Downstream of Old Cathole Road	7/3/2006	63	dry	
765	Downstream of Old Cathole Road	7/25/2006	305†	dry	
765	Downstream of Old Cathole Road	8/3/2006	530	dry	
765	Downstream of Old Cathole Road	8/10/2006	195†	dry	
765	Downstream of Old Cathole Road	8/16/2006	240	wet	
765	Downstream of Old Cathole Road	8/22/2006	200	dry	
765	Downstream of Old Cathole Road	8/31/2006	120	dry	
765	Downstream of Old Cathole Road	9/6/2006	129†	dry	
765	Downstream of Old Cathole Road	9/12/2006	31	dry	
765	Downstream of Old Cathole Road	6/6/2007	500	wet	258
765	Downstream of Old Cathole Road	6/13/2007	220	dry	
765	Downstream of Old Cathole Road	6/21/2007	130	dry	
765	Downstream of Old Cathole Road	6/27/2007	41	dry	
765	Downstream of Old Cathole Road	7/11/2007	305†	wet	
765	Downstream of Old Cathole Road	7/23/2007	215†	wet	
765	Downstream of Old Cathole Road	8/2/2007	235†	dry	
765	Downstream of Old Cathole Road	8/16/2007	200	dry	
765	Downstream of Old Cathole Road	8/23/2007	335†	dry	
765	Downstream of Old Cathole Road	8/28/2007	2200	dry	

Single sample *E. coli* (colonies/100 mL) data from all stations on the Skungamaug River (Segment 1b) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
765	Downstream of Old Cathole Road	5/22/2008	130	dry	233
765	Downstream of Old Cathole Road	6/4/2008	400	wet	
765	Downstream of Old Cathole Road	6/11/2008	310†	dry	
765	Downstream of Old Cathole Road	6/16/2008	260	wet	
765	Downstream of Old Cathole Road	6/23/2008	85	wet	
765	Downstream of Old Cathole Road	7/7/2008	300	dry	
765	Downstream of Old Cathole Road	7/31/2008	98	wet	
765	Downstream of Old Cathole Road	8/6/2008	1400	wet	
765	Downstream of Old Cathole Road	8/14/2008	180	dry	
765	Downstream of Old Cathole Road	8/20/2008	180	dry	
765	Downstream of Old Cathole Road	6/3/2009	170	dry	144
765	Downstream of Old Cathole Road	6/10/2009	230	wet	
765	Downstream of Old Cathole Road	6/25/2009	52	dry	
765	Downstream of Old Cathole Road	7/15/2009	85†	dry	
765	Downstream of Old Cathole Road	7/22/2009	98	wet	
765	Downstream of Old Cathole Road	7/29/2009	86	wet	
765	Downstream of Old Cathole Road	8/13/2009	485†	dry	
765	Downstream of Old Cathole Road	8/20/2009	250	dry	
765	Downstream of Old Cathole Road	9/2/2009	150	dry	

Single sample *E. coli* (colonies/100 mL) data from all stations on the Skungamaug River (Segment 1b) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
765	Downstream of Old Cathole Road	4/27/2010	85	wet	193
765	Downstream of Old Cathole Road	5/5/2010	41	dry	
765	Downstream of Old Cathole Road	5/11/2010	52	dry	
765	Downstream of Old Cathole Road	5/18/2010	230	wet	
765	Downstream of Old Cathole Road	5/25/2010	110	dry	
765	Downstream of Old Cathole Road	6/1/2010	230	wet	
765	Downstream of Old Cathole Road	6/8/2010	63	dry	
765	Downstream of Old Cathole Road	6/15/2010	74	dry	
765	Downstream of Old Cathole Road	6/22/2010	610	wet	
765	Downstream of Old Cathole Road	6/29/2010	120	dry	
765	Downstream of Old Cathole Road	7/6/2010	230	dry	
765	Downstream of Old Cathole Road	7/13/2010	170	wet	
765	Downstream of Old Cathole Road	7/20/2010	380	dry	
765	Downstream of Old Cathole Road	7/27/2010	96	dry	
765	Downstream of Old Cathole Road	8/3/2010	110	dry	
765	Downstream of Old Cathole Road	8/10/2010	570	dry	
765	Downstream of Old Cathole Road	8/17/2010	390	dry	
765	Downstream of Old Cathole Road	8/24/2010	750	dry	
765	Downstream of Old Cathole Road	8/31/2010	240	dry	
765	Downstream of Old Cathole Road	9/7/2010	190	dry	
765	Downstream of Old Cathole Road	9/14/2010	200	dry	
765	Downstream of Old Cathole Road	9/21/2010	530	dry	
765	Downstream of Old Cathole Road	9/28/2010	800	wet	

Shaded cells indicate an exceedance of water quality criteria

†Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for all stations on the Skungamaug River (Segment 1b)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
6133	Route 195 crossing	2010	4	7	385	700	274
6086	At Stafford Road	2010	0	2	18	NA	18
5600	Downstream of Route 74	2010	0	2	20	NA	20
765	Downstream of Old Cathole Road	2002-2003, 2006-2010	20	47	168	229	147
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gages at Hartford Bradley International Airport, CT.							

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